July 18, 1944. C. E. WOODDELL 2,353,864

REINFORCED ABRASIVE ARTICLE

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Fig. 1.

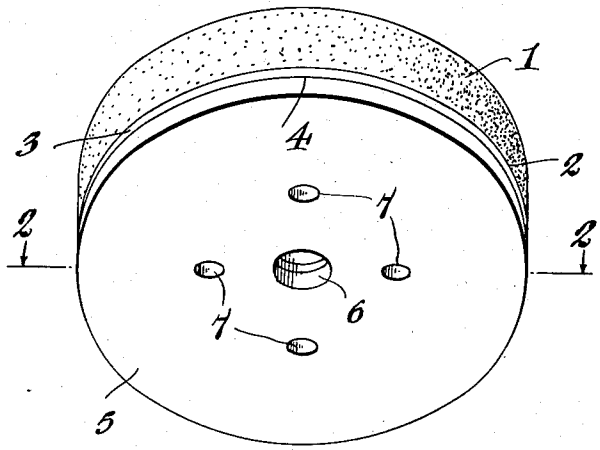
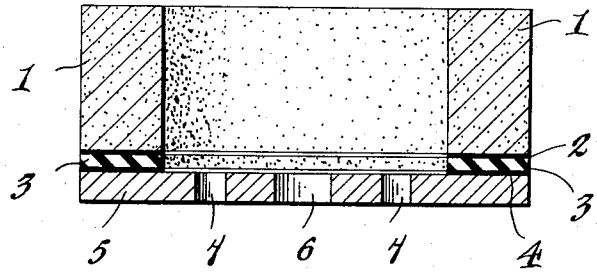


Fig. 2.



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REINFORCED ABRASIVE ARTICLE

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8 Claims. (Cl. 51—209)

This invention relates to bonded abrasive articles and more particularly to abrasive articles in which the abrasive portions of the articles are supported by rigid means such as backing plates secured to the flat faces of the abrasive sections. The invention has as a primary object the utilization of novel supporting plates for such purpose, whereby a reinforced bonded abrasive article results which is distinguished by its strength, safety, and the excellence of bond between the backing plate and the abrasive.

It is common in the art of making disc shaped grinding wheels, adapted to be mounted for grinding with the flat side face of the wheel, to employ a rigid metal supporting and reinforcing plate secured to one flat side face of the wheel as by being adhesively mounted thereon with a resilient tie bond interposed between the backing plate and the abrasive. Such resilient tie bond, which is most commonly made of rubber, is employed because of the great difference in coefficient of expansion of the backing plate of the abrasive and also because it is necessary to cushion the abrasive from driving shocks transmitted through the plate. If a yieldable means were not interposed between the reinforcing plate of metal or other similar rigid material and the abrasive the abrasive would be broken upon expansion of such reinforcing backing plate, which expansion occurs when the wheel becomes highly heated during severe grinding operations, and might also become weakened and eventually broken as a result of mechanical shocks transmitted through the backing. The use of metal for such reinforcing backing plate is not entirely satisfactory because of the difficulty of securing a satisfactory bond between such metal and the resilient tie bond. Furthermore, because of stresses locked into the metal as a result of its being rolled, metal backing plates become warped very readily during fabrication and after their assembly to the abrasive and the final curing of the adhesives employed. In making a metal backed wheel it is thus necessary to straighten the metal backing plate before its assembly with the abrasive but after it has had the central arbor hole machined therein and the several bolt holes around the arbor hole punched in it. In order to secure an adequate bond between the cement used to secure the resilient tie bond to the backing and the metal surface of the backing, the metal has to be sand-blasted in the portion to be cemented. Such sand-blasting results in setting up stresses while the backing plate and/or releasing stresses which were previously in equilibrium, and thus again the metal backing almost always becomes warped and has to be straightened before its assembly with the abrasive. The metals most frequently used as reinforcing plates are iron or steel. Such metals have to be very carefully painted in order to prevent their corrosion upon being subjected to the action of grinding coolants which frequently contain alkali or caustics. Furthermore, if a ferrous backing begins to rust at the interface between it and the adhesive, such rusting continues and results in a progressive deterioration of the bond between the backing and the abrasive.

When a metal backing is employed in a wheel of the type described, it must be finished accurately to size before its assembly in the wheel. The abrasive portions of the assembled wheel are finished with reference to the surfaces of the metal backing. Care must be taken not to advance the tool employed in finishing the outer curved surface of the abrasive into contact with the metal backing, since such action results in damage to the tool, which is not designed for metal cutting.

The backing employed in the reinforced wheel of the present invention overcomes the difficulties which have been outlined above in connection with the use of metal backing plates. The backing of the present invention is such as to provide a very strong joint between it and the resilient tie bond, is chemically inactive toward water and grinding coolants, and is of such character as to be able to be cut to finished diameter by the same tool which finishes the outer surface of the abrasive body. In addition the reinforcing material is strong and rigid, so that by itself without the necessity of added reinforcement, it makes a backing suitable for high speed wheels having deep abrasive annuli operating under the most severe grinding conditions.

The invention will be more readily understood by reference to the accompanying drawing in which:

Figure 1 is a perspective view of a reinforced disc shaped grinding wheel made in accordance with the present invention, and

Figure 2 is a view in cross section taken along the line II—II in Figure 1.

The reinforced abrasive article shown in the drawing consists of a bonded abrasive annulus 1 secured to a layer of resilient tie bond 3 by means of an interposed layer of adhesive 2. Tie bond 3 is in turn bonded to reinforced backing plate 5 by means of an interposed layer of adhe-

sive 4. The backing plate 5 is provided with a concentric central arbor hole 6 and holes 7 spaced around the central hole for the reception of bolts securing the backing plate to a mounting plate (not shown). Backing plate 5 consists of an integral rigid structure resulting from the compacting together of layers of resin impregnated felted fibers, as for instance resin impregnated paper layers, and the subsequent curing of such resin to a firm, hard, waterproof condition. A suitable material for this purpose is one sold under the name "Panelyte" which is a product sold by the Panelyte division of the St. Regis Paper Company, New York, N. Y. A "Panelyte" which has proven used in the present invention is one designated "Panelyte" grade 260, which has the following properties:

Tensile strength—flat, with grain lbs./sq. in.	15,300
Flexural strength—flat, with grain lbs./sq. in.	22,300
Flexural strength—flat, across grain lbs./sq. in.	20,100
Bonding strength—1" x 1" x ½"—lbs.	785
Density—g./cm.^{3}	1.35

The word "grain" employed in the above table denotes the orientation of the parallel planes in which the successive layers of felted fibers lie.

It is to be understood that this invention is not limited to the use of the specific backing material above set out as the reinforcing plate, but that it is meant to include laminated resin impregnated felted fiber products having at least the following minimum properties:

Tensile strength—flat, with grain lbs./sq. in.	10,000
Flexural strength—flat, with grain lbs./sq. in.	16,000
Flexural strength—flat, across grain lbs./sq. in.	13,000
Bonding strength—1" x 1" x ½"—lbs.	700
Density—g./cm.^{3}	1.25

Such material must also be such that it retains these properties substantially unimpaired when heated to temperatures required to cure the tie bond and the adhesive layers, if such are used. A typical curing temperature is 300° F.

By the term "felted fiber" above is meant felted fibers of cellulose, or of non-cellulosic materials such as asbestos, wool, silk, nylon, Vinyon, and protein. Among the resins which may be employed to impregnate such felted products and to bond them together are phenol-formaldehyde, cresol-formaldehyde, urea-formaldehyde, and melamine.

The reinforced wheel shown in Figures 1 and 2 may be made as follows: A disc of a backing material of the type disclosed above consisting the resin impregnated felted fiber layers compacted and cured together to the desired thickness, as for instance ¼" with the felted layers parallel to the broad faces of the finished sheet, is rough sawed from a sheet of such material, the disc cut being slightly larger than the desired finished wheel diameter, and then has central arbor holes 6 and bolt hole 7 drilled therein. The surface of backing 5 to be bonded to the tie bond is lightly sand-blasted to remove the finish glaze and render it suitable for bonding. The sand-blasted annular surface of the backing is then coated with a thin layer of a suitable cement. One such cement consists of 830 grams chlorinated rubber dissolved in 3300 cc. a suitable solvent. Another cement suitable for this purpose is composed of compounded polychloroprene capable of vulcanization broken down to cement form in a solvent such as benzol or toluol. Two commercial cements which have also been found to be highly satisfactory for this purpose are those sold on the market as Bostik M–117 and Bostik M–162.

An annular molded abrasive body which is to be bonded to the backing has one broad surface thereof cleaned and air-blasted to remove dust therefrom. Such cleaned surface is then coated with a thin layer of cement which may be any one of the chlorinated rubber type above disclosed, the compounded polychloroprene in a solvent, or the commercial Bostik cements. The coated reinforcing backing and the cement coated abrasive annulus are then placed in an oven and heated for ½ hour at 250° F. Following such heating the reinforcing backing and the abrasive are assembled with a layer usually $\frac{1}{32}$" or $\frac{1}{16}$" thick of an elastomer such as uncured polychloroprene between them to function as a tie bond, the cement layers on both backing and the abrasive contacting such tie bond. The assembly is then placed in a hot press and subjected to a temperature of 300° F. for 25 minutes under a pressure of 100 pounds per square inch to cure the tie bond and cement layers and to bond the parts of the assembly firmly together.

The foregoing procedure is illustrative of the process. It is to be understood that numerous variations are possible both as to materials employed as the layers of cement and as the tie bond, as well as in the time and temperature employed during heating and the pressure to which the parts are subjected are concerned. When a tie bond composed of polychloroprene is employed it is not always necessary to employ layers of cement on the backing and the abrasive body. When heated at temperatures of approximately 300° F. for approximately ½ hour at pressures in the neighborhood of 100 pounds per square inch, the polychloroprene becomes cured to a tough resilient condition and by itself becomes bonded to the reinforcing backing plate and the molded abrasive body.

Tie bonds composed of copolymers of butadiene with other copolymerizable compounds such as acrylic acid nitrile or styrene may also be used. When such materials, which are the well-known Buna type synthetic rubbers, are employed, it is necessary to use layers of cement both on the reinforcing backing plate and the abrasive body to secure an adequate bond between them and the Buna synthetic rubber tie bond. Instead of such synthetic elastomers, a layer of natural rubber may also be used as a resilient bond for tying the reinforcing plate to the abrasive.

Although the invention has been illustrated by reference to a reinforced abrasive wheel, it is to be understood that the invention finds utility among reinforced abrasive articles generally where it is necessary to employ a reinforcing plate which may also be used as the means for supporting and/or driving the abrasive article. Furthermore, a reinforced abrasive wheel within the scope of the present invention need not have the abrasive body in one piece as shown but may, for example, have the abrasive made up of a plurality of portions. Such portions may be, for instance, segments which may be joined together to form an annulus by means such as layers of cured cement. Such composite abrasive body

may then be bonded to the backing in the manner disclosed. Alternatively, the abrasive sections may be separately mounted on the backing and such sections bonded subsequent to their mounting by means of adhesive such as heat hardenable resins or rubber cements.

Having thus fully disclosed my invention, I desire to claim as new the following:

1. A reinforced abrasive article comprising a bonded abrasive body, a rigid reinforcing backing plate therefor, said backing plate being adhesively secured to the bonded abrasive article by means comprising a resilient tie bond, said reinforcing backing plate having high strength and being composed of a plurality of layers of felted fibers compressed together and impregnated with synthetic resin cured to a strong hard condition.

2. A reinforced abrasive article comprising a bonded abrasive body, a rigid reinforcing backing plate therefor, said backing plate being adhesively secured to the bonded abrasive body by means comprising a resilient tie bond, said reinforcing backing being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong hard condition, said reinforcing plate having a tensile strength of at least 10,000 pounds per square inch in any direction parallel to its broad surface.

3. A reinforced abrasive article comprising a bonded abrasive body, a rigid reinforcing backing plate therefor, said backing plate being adhesively secured to the bonded abrasive body by means comprising a resilient tie bond, said reinforcing backing plate being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong hard condition, said reinforcing plate having a tensile strength of at least 10,000 pounds per square inch in any direction parallel to its broad surfaces, a bonding strength of at least 700 pounds per square inch in pieces ½'' thick and a specific gravity of at least 1.25.

4. A reinforced abrasive article comprising an annular bonded abrasive body, a rigid reinforcing backing plate therefor, in the form of a disc, said backing plate being adhesively secured to a broad side surface of the abrasive by means comprising a resilient tie bond, said reinforcing backing plate being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong, hard condition, said reinforcing plate having a tensile strength of at least 10,000 pounds per square inch in any direction parallel to its broad surface.

5. A reinforced abrasive article comprising an annular bonded abrasive body, a rigid reinforcing backing plate therefor, in the form of a disc, said backing plate being adhesively secured to a broad side surface of the abrasive by means comprising a resilient tie bond, said reinforcing backing plate being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong, hard condition, said reinforcing plate having a tensile strength of at least 10,000 pounds per square inch in any direction parallel to its broad surface, a bonding strength of at least 700 pounds per square inch in pieces of ½'' in thickness and a specific gravity of at least 1.25.

6. A reinforced abrasive article comprising a bonded abrasive body, a rigid reinforcing backing plate therefor, said backing plate being adhesively secured to the bonded abrasive body by means comprising a resilient tie bond, said reinforcing backing plate being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong hard condition, said reinforcing plate having a tensile strength of at least approximately 15,000 pounds per square inch in a direction parallel with the alignment of the fibers, a bonding strength of at least approximately 780 pounds per square inch, ½'' in thickness and a specific gravity of at least approximately 1.35.

7. A reinforced abrasive article comprising an annular bonded abrasive body, a rigid reinforcing backing plate therefor, in the form of a disc, said backing plate being adhesively secured to a broad side surface of the abrasive by means comprising a resilient tie bond, said reinforcing backing plate being composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong, hard condition, said reinforcing plate having a tensile strength of at least approximately 15,000 pounds per square inch in a direction parallel with the direction of fiber alignment, a bonding strength of at least 780 pounds per square inch in pieces ½'' in thickness and a specific gravity of at least approximately 1.35.

8. The method of making a reinforced grinding disc which comprises providing an annular bonded abrasive body, providing a backing disc composed of a plurality of layers of felted fibers which are resin impregnated, said layers being compressed together and the resin being cured to a strong hard condition, said backing disc being of a diameter appreciably greater than that of the annular abrasive body, adhesively securing the backing plate to the abrasive body by means of a cured resilient tie bond in such relation that the backing disc and the abrasive body are at least substantially coaxial, and finishing the reinforcing disc and the outer surface of the annular abrasive body in the same step by mounting the wheel in a lathe and employing the same cutting or dressing tool to reduce the diameter of the backing disc and abrasive body.

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